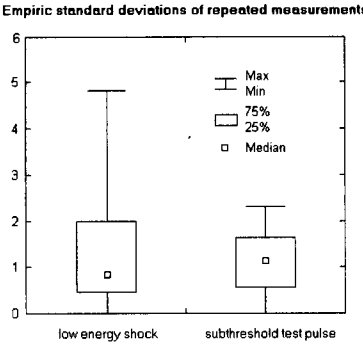
shock (CC=0.73, 95% CI 0.54 to 0.85). Box plots (figure) illustrate intra-individual variability of HVI measurements.



Conclusions: Compared to a low energy shock, HVI measurements using a subthreshold test pulse have a) higer reproducibility and b) higher correlation to HVI measurement using high energy shocks. Safe and painless HVI testing with a subthreshold pulse might therefore help to detect ICD lead failure during routine follow-up.

1092-116 Safety and Efficacy of Coronary Sinus Venography During Iatrogenic Asystole for Biventricular Pacing

Imran K. Niazi, Andre Go, Charles J. Lanzarotti, James McPike, Dana I. Kappel, *Wisconsin Center for Clinical Research, Milwaukee, Wisconsin.*

Background: Coronary sinus (CS) anatomy is usually visualized prior to placement of a CS branch lead for left ventricular (LV) pacing. Three methods of coronary sinus venography (CSV) were compared, for safety and efficacy, in 42 patients (pts) undergoing biventricular device implant.
Methods: All pts had congestive heart failure, QRS>120msec, and a mean LVEF of 22.8 ± 7.6% (95% confidence interval). 35 were male. Three methods of CSV were assessed: injection into the main CS during normal sinus rhythm (CSV-NSR), injection during asystole induced with adenosine 6-18mg IV (CSV-A), and balloon-occlusive venography (BOV) using a Swan-Ganz catheter to occlude the CS during distal injection. A total of 87 venograms were compared for adequate visualization of the target branch (where LV lead was placed), and total number of branches seen. The location of the target branch with each method was also assessed.
Results:

	CSV-NSR (n=41)	CSV-A (n=25)	BOV (n=21)
Branches visualized (95% CI)	0.9 ± 0.8	1.8 ± 0.9*	2.4 ± 1.0**
Target branch visualized (95% CI)***	12/41 (18.1% - 45.4%)	20/26 (60.6% - 91.3%)	19/20 (75.1% - 98.8%)
Target branch location, anterior/ lateral	9/12 (75% lateral)	14/19 (74% lateral)	9/21 (43% lateral)

*p<.001 vs CSV-NSR **p= .026 vs CSV-A, paired t-test, 95% CI, ***exact binomial distribution
2 pts suffered minor CS dissection from BOV; 4 pts had a temporary rise in serum creatinine following contrast injection.
Conclusion: 1) CS injection in asystole is the preferred method of CSV, particularly when lateral lead placement is desired; 2) balloon occlusive venography is frequently necessary for anterolateral lead placement, but carries a slightly higher risk.

POSTER SESSION

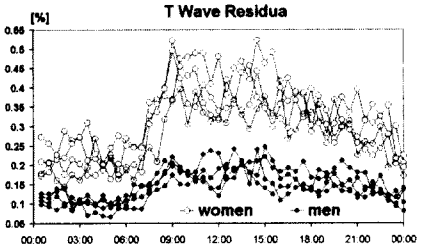
1093 Noninvasive Testing: Measuring Ventricular Repolarization

Monday, March 18, 2002, 9:00 a.m.-11:00 a.m.
Georgia World Congress Center, Hall G
Presentation Hour: 10:00 a.m.-11:00 a.m.

1093-105 Depolarisation and Repolarization Heterogeneities Differ Between Men and Women

Velislav N. Batchvarov, Peter Smetana, Azad Ghuran, Katerina Hnatkova, Monica Harries, Ann Marie Murtagh, A John Camm, Marek Malik, *St.George's Hospital Medical School, London, United Kingdom.*

The non-dipolar ECG components (i.e. components that do not represent the cardiac dipole) reflect local electrical irregularities (i.e. electrical heterogeneity). We compared the non-dipolar components of the QRS (QRS residua, QRS-R) and of the T wave (T wave residua, T-R) and their circadian pattern in healthy men and women.
Methods: 24-hour 12-lead digital ECGs (SEER MC, GE Marquette, one ECG every 30 seconds) were recorded 4 times (at baseline, after 1 day, 1 week and 1 month) in each of 46 healthy subjects (22 men, age: men 27±7 years, women 27±8 years). QRS-R and T-R were calculated using singular-value decomposition and were expressed as proportion (%) of the whole energy of the ECG signal.
Results: In all 4 recordings, T-R were significantly greater in women (0.31±0.01 vs 0.15±0.005%, p<0.0000001), while QRS-R were significantly greater in men (0.46±0.003 vs 0.32±0.002%, p<0.0000001). T-R exhibited circadian pattern with midday peak (09:00-15.00), which was more pronounced in women (Figure). There was no detectable circadian pattern of QRS-R.
Conclusions: Depolarisation and repolarisation heterogeneity are gender-dependent. Repolarisation heterogeneity is greater in women, while depolarisation heterogeneity is greater in men. Unlike depolarisation, repolarisation heterogeneity exhibits circadian pattern. These findings might have a link to the gender differences in repolarisation-related ventricular arrhythmias and to the circadian pattern of the frequency of cardiac events.



1093-106 Characteristics of Activation Recovery Interval Dispersion From the Whole Chest in Normal Children and in Children With Prolonged QT

Naomi Izumida, Yuh Asano, Shouzaburoh Doi, Hiroko Wakimoto, Tadahiro Yoshikawa, Masatoshi Imamura, Natsuko Suzuki, Seiko Kawano, Tohru Sawanobori, Masayasu Hiraoka, *Tokyo Medical and Dental University, Tokyo, Japan.*

Background: To determine inhomogeneity in ventricular repolarization, which relates to the genesis of arrhythmias, QT dispersion of 12 leads ECG has been used. However, it has several problems as difficulty of offset determination of T wave and small number of leads to cover entire heart. Activation recovery interval (ARI) well correlates to the local action potential duration and it can be determined more accurately as a peak of first derivative (dV/dt) wave during STT than T wave offset. Therefore we studied the usefulness of ARI dispersion from 87 leads on whole chest in children.
Method: As to control values, 100 healthy children of 0-15 years old were compared to 20 children with QT prolongation (PQT: QTc> 0.45) of 6 -15 years old. Healthy children were divided into 3 subgroups by age. Children with PQT were classified into asymptomatic with no family history (aPQT group, 15 cases) and those with syncope or familial history (sPQT group, 5 cases). ECGs of 87 leads on whole chest were recorded using a mapper (HPM-6500 or VCM-3000) and ARI was measured as the interval between minimum dV/dt during QRS and maximum dV/dt during ST-T. ARI dispersion (ARId) was defined as a difference of the maximum and the minimum value of ARI of 87 leads and the values were also corrected by Bazett formula (ARIcd).
Results: Heart rate, ARId, and ARIcd of 0-4 years subgroup (37cases) were 103±13 beat/min, 116±25 ms, and 152±30 ms (mean ± SD), respectively. In 5-9 years subgroup (35 cases), they were 84±10, 129±16, 153±22, and 10-15 years subgroup (28 cases) 76±14, 130±17, 145±21, respectively. In control group, heart rate and ARId changed with age, whereas ARIcd showed the constant value independent of age. In 14 of 15 aPQT group, ARId and ARIcd were within mean±2SD values, whereas ARId and ARIcd in sPQT group were larger than mean+2SD values of age matched control subgroup. The sensitivity, specificity, and accuracy of ARId and ARIcd for detection of sPQT group were 100%, 83%, and 95%, respectively.
Conclusion: ARId and ARIcd were significantly large in symptomatic prolonged QT children. ARId and ARIcd may reflect inhomogeneity of the repolarization and they are applicable to predict the risk of children with prolonged QT.

1093-107 Beta-Adrenergic Influences on T Wave Alternans During Pacing in Patients With and Without Ventricular Tachyarrhythmia

Norihiro Komiya, Shinji Seto, Kojiro Nakao, Kiyotaka Matsuo, Hisashi Doi, Motonobu Hayano, Katsusuke Yano, *The Third Department of Internal Medicine,Nagasaki University School of Medicine, Nagasaki, Japan.*

Backgrounds: T wave alternans (TWA) is a measure of ventricular vulnerability. Relation of TWA to adrenergic activity is not assessed clinically. This study was to evaluate (1) whether adrenergic influence on TWA is observed clinically, and if so, (2) whether responses of TWA to changes in adrenergic activity are relevant to patients (pts) with ventricular tachyarrhythmia (VT).
Methods: 35 pts (28 M, 7 F; 58+/-14 years) consisted of 24 with supraventricular arrhythmia and 11 with VT are included. The magnitude of TWA in lead Vector Magnitude (eMV) was measured during atrial pacing of 90 and 110 ppm. Adrenergic influence on TWA was examined comparing eMV of on baseline and after 2 mg/kg of propranolol (PRO) infusion. In 12 pts (5 with VT, 7 without VT), eMV was also measured during 0.01 microgram/kg/min of isoproterrenol (ISP) infusion.
Results: The eMV in whole 35 pts decreased from 1.42+/-1.14 to 0.61+/-0.87 (p<0.05) by PRO at 110 ppm, and ISP increased to 3.64+/-3.25 . Effect of PRO and ISP on eMV in pts with and without VT were summarized in Table. On baseline, eMV was larger in VT pts (p<0.05). However, after PRO, a greater diminution of eMV was observed in VT pts (p<0.05). Contrarily, ISP caused a lesser increase of eMV in VT pts.
Conclusion: TWA was regulated, at least partly, by beta-adrenergic activity. Characteris-

tics in VT pts were larger diminution of TWA after beta-blockade and smaller increase during beta-stimulation; suggesting an augmentation of intrinsic beta-adrenergic activity in VT pts.

Effect of PRO and ISP on eMV in pts with and without VT.
*** P < 0.05 versus baseline**

	VT 90 ppm	Non VT 90ppm	VT 110ppm	Non VT 110ppm
baseline	1.32+/-0.47	0.29+/-0.29	2.45+/-0.97	1.16+/-0.94
PRO	0.47+/-0.33*	0.28+/-0.48	0.89+/-0.40*	0.45+/-0.65*
ISP	1.58+/-1.73	1.67+/-1.84	3.06+/-2.01	3.88+/-3.82

1093-108 Female Gender Is Associated With a Decreased Prevalence of T Wave Alternans

Laura A. Murphy, Eric J. Rashba, Stephen R. Shorofsky, Karen MacMurdy, Michael R. Gold, *University of Maryland, Baltimore, Maryland.*

Background: Gender has important influences on cardiovascular disease including arrhythmias. Women have a lower incidence of sudden cardiac death (SCD), but the mechanisms underlying this observation are poorly understood. T-wave alternans (TWA) is an important marker of ventricular arrhythmia vulnerability. However, the effects of gender on this measure have not been evaluated.
Methods: This was a prospective study of 251 patients with ischemic heart disease and left ventricular dysfunction (ejection fractions ≤ 40%). The patients underwent electrophysiology study (EPS) and measurement of TWA as part of the evaluation of suspected ventricular arrhythmias in the absence of antiarrhythmic drugs or beta blockers.
Results: The cohort was 19% female with a mean age of 65 ± 10 years and a mean ejection fraction of 27 ± 8%. Women had higher ejection fractions (29 ± 9 vs. 27 ± 8, p=0.03), lower rates of inducible arrhythmias (56% vs 69%, p= 0.09), were less likely to be receiving beta blockers chronically (48% vs 67%, p= 0.02) and were less likely to have positive TWA tests (42% vs 63%, p=0.02). Multivariate analysis of 10 clinical factors using TWA as the dependent variable revealed that female gender (OR 0.4, 95% CI 0.2-0.8, p=0.007), age (OR 1.04 per year interval, 95% CI 1.01-1.07, p=0.007), and digoxin therapy (OR 2.5, 95% CI 1.3-4.7, p=0.006) were independent predictors of TWA.
Conclusions: Women are less likely to have abnormal TWA. Since TWA may be mechanistically related to the pathogenesis of SCD, this finding could contribute to the lower incidence of SCD among women.

1093-109 Different Characteristics of T Wave Alternans Between Polymorphic Ventricular Tachycardia and Monomorphic Ventricular Tachycardia

Kaoru Tanno, Youichi Kobayashi, Takashi Katagiri, *Showa University, Tokyo, Japan.*

[Background] Microvolt T wave alternans (TWA) has been reported to be closely associated with polymorphic ventricular tachycardia (VT) in animal experiments. However, it is not clear whether monomorphic VT (monoVT) has relation to TWA as closely as polymorphic VT (polyVT). [Method] The subjects were 59 patients (male/female=51/8, mean age 60 ± 13 years) with organic heart disease and ventricular tachyarrhythmias. We compared TWA of patients with polyVT with that of patients with monoVT. Programmed ventricular stimulation was performed at right ventricular apex and outflow tract to induce sustained ventricular tachyarrhythmias. Recordings of TWA were made in sinus rhythm and with atrial pacing at 80, 90, 100, and 110 beat per minute if conducted without atrioventricular block for 3 minutes respectively with CH2000 system (Cambridge Heart Co. Boston, MA). TWA was considered positive when the alternans voltage (Valt) was >1.9μV and the alternans ratio was >3 for a period of more than 1 minute in VM, X, Y, Z, or two adjacent precordial leads.
[Results] Electrical stimulation induced polyVT in 13 patients and monoVT in 20 patients. TWA was positive in all patients in polyVT group, while 15 of 20 patients in monoVT group had positive TWA. Although onset heart rate was not significantly different between two groups, onset heart rate/target heart rate (220-age) of polyVT group was significantly lower than the other group (polyVT: 58 ± 11 vs. monoVT: 63 ± 8, None: 68 ± 9 %, p<0.05). Valt of polyVT group at X lead during 110 bpm was significantly higher than the other group (polyVT: 3.6 ± 2.4 vs. monoVT: 1.4 ± 1.3, None: 1.8 ± 1.9μV, p<0.05). During 29 ± 12 months follow-up periods, Vf recurred in 4 patients of polyVT group and VT recurred in 7 patients of monoVT group. All patients with recurrence of ventricular tachyarrhythmias were positive in TWA.
[Conclusion] Polymorphic VT could be more closely associated with TWA than monomorphic VT. Microvolt TWA might be a powerful tool for predicting recurrence of ventricular tachyarrhythmias in patients with organic heart disease.

1093-110 Effect of B-Blocker Therapy for T-Wave Alternans and Cardiac Sympathetic Function in Patients With Nonischemic Heart Disease

Mariko Murata, Masahiko Harada, Akihiko Shimizu, Makoto Kubo, Reo Mitani, Yuka Dairaku, Masunori Matsuzaki, *The Second Department of Internal Medicine, Yamaguchi University School of Medicine, Ube, Japan, The Faculty of Health Science, Yamaguchi University School of Medicine, Ube, Japan.*

Background: We have reported that cardiac sympathetic denervation was related to the presence of T-wave alternans (TWA) in patients with non-ischemic heart disease (NIHD) in the previous ACC meeting. Recently, it has been observed that mechanical alternans disappeared with the improvement of left ventricular ejection fraction (EF) with ß-blocker therapy in patients with DCM. The aim of this study was to investigate whether TWA findings also improve together with the improvement of cardiac sympathetic denervation and EF with ß-blocker in positive TWA patients with NIHD.
Methods: Eighteen positive TWA patients with NIHD not treated with ß-blockers were enrolled. The TWA test, I-123 metaiodobenzylguanidine (MIBG) scintigraphy, and echocardiography were performed at baseline and after 3 months of treatment with ß-blockers. Using alternans voltage of the vector magnitude (Valt) in the TWA test, the decrease rate of Valt (% Valt) was calculated {% Valt=(pre Valt- post Valt)/pre Valt *100; pre: before administration, post: after administration}. The heart/mediastinal count ratios in the early phase (eH/M) and delayed phase (dH/M), and the washout rate (WR) were calculated using MIBG scintigraphy, and EF was measured with echocardiography. The rate of change between baseline and after administration was calculated using the following formula {% eH/M=(post eH/M- pre eH/M)/pre eH/M *100, % dH/M=(post dH/M- pre dH/M)/pre dH/M *100, % WR=(post WR- pre WR)/pre WR *100, % EF=(post EF- pre EF)/pre EF *100}. Simple regression analysis was performed to examine the relationship between each parameter obtained from MIBG or echocardiography and % Valt.
Results: Significant negative correlations were recognized between pre eH/M, pre dH/M or pre EF and % Valt (eH/M: R =0.62, p < 0.01, dH/M: R =0.62, p <0.01, EF: R=0.52, p<0.05). Significant positive correlations were also seen between % eH/M, % dH/M or % EF and % Valt (% eH/M: R =0.57, p < 0.05, % dH/M: R =0.68, p < 0.01, % EF: R =0.50, p < 0.05).
Conclusion: TWA findings improved together with the improvement of cardiac sympathetic denervation and EF with ß-blocker therapy in positive TWA patients with denervation and systolic dysfunction.

1093-111 Combination of Dispersions of QRS Duration and QT Interval Improves a Predictive Value of Mortality in Patients With Mild to Moderate Chronic Heart Failure

Takahisa Yamada, Masatake Fukunami, Tsuyoshi Shimonagata, Kazuaki Kumagai, Akio Hirata, Mitsutoshi Asai, Hidetaka Kioka, Noritake Hoki, *Osaka Prefectural General Hospital, Osaka, Japan.*

Background: The possible predictive value of the dispersion of QRS duration (QRSd) as the marker of the inhomogenity of ventricular depolarization is unknown in patients with chronic heart failure (CHF), although QT dispersion (QTd) as the marker of the inhomogenity of ventricular repolarization has been reported to be related to poor prognosis in patients CHF. The aim of this study is to prospectively evaluate the prognostic significance of QRSd and to compare the predictive value of QRSd with that of QTd in patients with mild to moderate CHF.
Methods: We studied 87 consecutive stable outpatients with sinus rhythm whose radionuclide left ventricular ejection fraction was less than 40% (30±8%, NYHA: 1.9±0.7). Before the entry, the signal-averaged ECG was recorded from the standard 12 leads, and QRSd was defined as the difference between the maximum and minimum of filtered QRS duration in all of the leads. QTcd was determined by subtracting the shortest corrected QT interval by the Bazett's formula from the longest one in the standard 12-lead ECG. We calculated QTcd at rest and just after Master double stress test (QTcd[ex]).
Results: During the follow-up period of 49±18 months, 11 patients had cardiac death (sudden death in 9 and heart failure death in 2). At multivariate Cox analysis, out of the variables including clinical, hemodynamic, echocardiographic, neurohumoral parameters, QRSd and QTcd[ex] was independently associated with the cardiac death (QRSd:p=0.0002, hazard ratio 1.268 [1.121 to 1.433]; QTcd[ex]: p=0.01, hazard ratio 1.034 [1.008 to 1.061]). Kaplan-Meier analysis revealed that the cardiac death were significantly (p=0.0015) more often observed in patients with both abnormal QRSd (>25ms) and QTcd[ex] (>62ms) than those with either abnormal QRSd or QTcd[ex]. The positive predictive value was significantly greater in patients with both abnormal QRSd and QTcd[ex] than those with either abnormal QRSd or QTcd[ex] (63% vs 15%, p=0.01).
Conclusion: The combination of dispersions of QRS duration and QT interval would identify higher risk subset of cardiac death in patients with mild to moderate CHF.

ORAL CONTRIBUTIONS

815 Insights Into Biventricular Pacing for Congestive Heart Failure

Monday, March 18, 2002, 11:00 a.m.-12:15 p.m.
Georgia World Congress Center, Room 254W

11:00 a.m.

815-1 Reverse Mechanical Remodeling by Biventricular Pacing in Congestive Heart Failure: One-Year Results From Patients in Sinus Rhythm in the MUSTIC (MUltisite STimulation In Cardiomyopathy) Study

Cecilia Linde, Serge Cazeau, Lukas Kappenberger, Richard Sutton, Christophe Bailleul, Jean-Claude Daubert, on behalf of the MUSTIC Study Group, *Karolinska Hospital, Stockholm, Sweden.*

Background: The MUSTIC study is a controlled multicentre trial, to assess the clinical efficacy of biventricular pacing (BIV) in patients with chronic NYHA III heart failure and intrinsic QRS >150 or RV paced QRS >200 ms. We have reported symptomatic relief from the crossover phase (CO) with sustained results over a year. The aim of this study was to assess if left ventricular function improves over time in the group of patients with sinus rhythm with no pacing indication.
Methods: Of 67 included patients 48 completed the 6 month CO single blind comparison of BIV and no-BIV. Of these 46 preferred and were programmed to BIV and followed longitudinally by clinical parameters, Doppler echocardiography and left ventricular (LV) ejection fraction measured by radionucleides.